HIDEX-BP Calibrations

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LONG-TERM GOALS

My research objectives involve determining how low light phenomena, both bioluminescence and solar radiation below 200 meters, influence the distribution and behavior of marine organisms.

OBJECTIVES

The objective was to develop a portable calibration source which can replace the ^{14}C-phosphor standard originally designed for the calibration of the High Intake Defined Excitation Bathyphotometers (HIDEX-BP) (Widder et al., 1993). Because of restrictions on the transport of radioactive material, the Naval Oceanographic Office requires a non-radioactive standard that can be used to test calibration in the field.

APPROACH

A Thulium rare earth doped fiber optic was obtained and tested as a possible linear (1 meter long) calibration source. Laser alignment proved to be hypercritcal and the fiber was found to be too fragile for field conditions. A low-cost, robust alternative was found using a multi-mode side-emitting fiber bundle, sheathed in clear Tygon tubing and coupled to a blue LED. The light wand was designed to produce four different intensities. The intensity range was selected based on data provided by Mark Geiger at NAVOCEANO in order to provide a multi-point calibration over the range of photon fluxes normally seen in field measurements. The wand was spectrally calibrated with an EG&G 1420 Optical Multi-channel Analyzer. Total photon flux was determined for each setting in a radiometrically calibrated integrating sphere.

WORK COMPLETED

Three calibration wands were built and calibrated. These units are rugged and field portable. Unit 1 has been delivered to NAVOCEANO for calibration of their HIDEX-BP.

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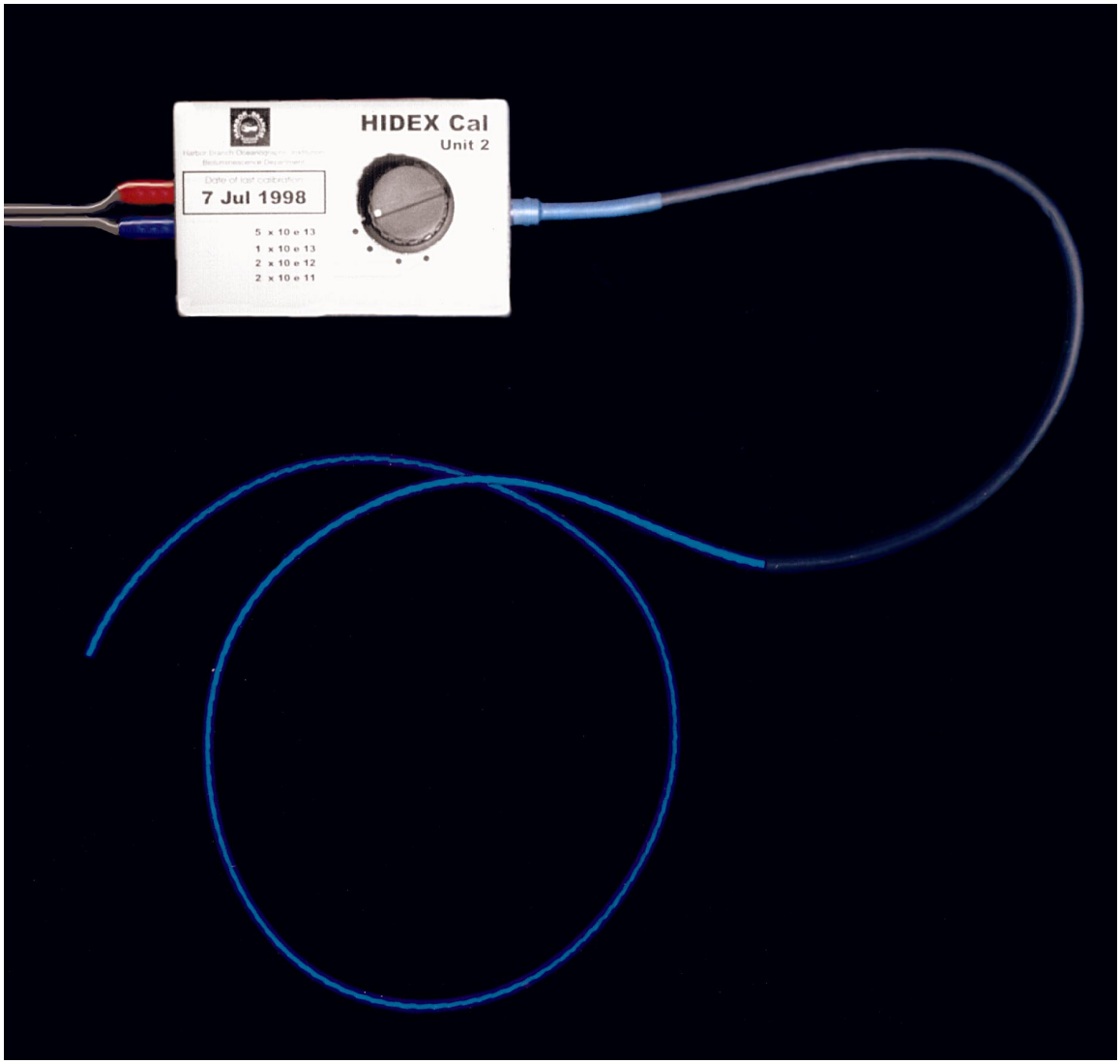

Figure 1. Calibration light wand.

RESULTS

Spectral emission of the light wand calibration source is a good match for bioluminescence with a peak emission of 477 nm. Photon flux at each of the four settings used is 2×10^{11}, 2×10^{12}, 1×10^{13}, and 5×10^{13}.

IMPACT

The design and calibration of the HIDEX-BP was dictated by the need to develop a bathyphotometer system that could rapidly and reliably provide accurate measurements of stimulated bioluminescence in the oceans. Given the very large number of planktonic organisms that are bioluminescent, well defined and calibrated measurements of stimulated bioluminescence can provide valuable information about how organisms are distributed relative to the physical and chemical features of their environment, as well as provide real numbers for calculating the impact

which bioluminescence may have on covert naval operations. The unique geometry of the HIDEX-BP design, which basically uses an integrating cylinder, poses unique calibration problems. The fiber optic calibration source addresses these issues directly and should greatly enhance the accuracy and reliability of these systems, which are providing valuable oceanographic data for basic research and for mission planning.

TRANSITIONS

The Unit 1 calibration wand was sent to Mark Geiger at NAVOCEANO in July 1998 and will be used to maintain calibration on their HIDEX-BP. Unit 2 will remain in our laboratory to maintain calibration of the UCSB HIDEX-BP which has been transitioned to the Bioluminescence Department at Harbor Branch Oceanographic Institution. It will also be used to calibrate the Mini-HIDEX, which is currently under development in our laboratory. Unit 3 will be available to send out as needed to calibrate such related systems as TOWDEX and MOORDEX (Case et al., 1993, Widder, 1997).

RELATED PROJECTS

A low cost, compact bioluminescence detector is currently under development in our laboratory. Based on the same design principles used to develop the HIDEX-BP, this system is intended to reduce the complexity and size of the package in order to extend the utility of these systems and make them more accessible to the oceanographic community. The fiber optic calibration source is being used to calibrate this system and provide direct comparison with HIDEX-BP measurements.

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